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NATIONAL DAM SAFETY PROGRAM. STONY LAKE DAM (NJ00263), DELAWARE--ETC(U)
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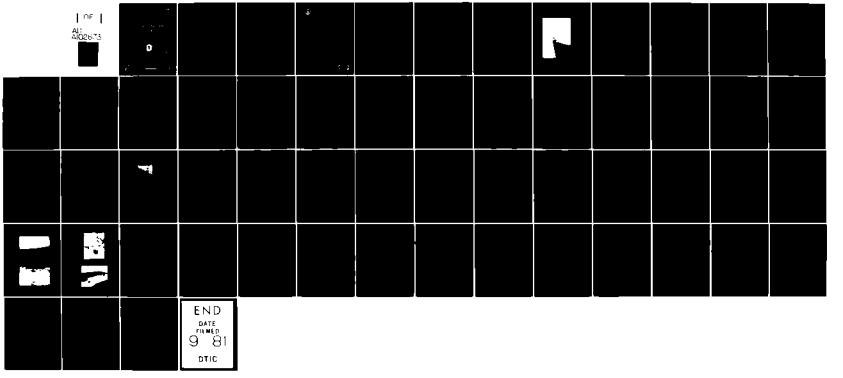

LEVEL II

AD A102673

DELAWARE RIVER BASIN
STONY BROOK, SUSSEX COUNTY
NEW JERSEY

STONY LAKE DAM
NJ00263

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

JULY 1981

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REPT NO: DAEN/NAP-53842/NJ00263-81/07

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered) (10) Abraham/Perera

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

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16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dams	National Dam Safety Program	Spillway
Embankments	Stony Lake Dam, NJ	Seepage
Visual Inspection	Delaware River Basin	
Structural Analysis	Stony Brook, NJ	
Weir	Sussex County, NJ	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-N

22 JUL 1981

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Stony Lake Dam in Sussex County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Stony Lake Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. The dam's spillway is considered inadequate because a flow equivalent to 16 percent of the One Hundred Year Flood would cause the dam to be overtopped. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway is inadequate. However, additional hydraulic and hydrological studies are not recommended since the entire dam functions as an overflow weir.

b. Within twelve months from the date of approval of this report the following remedial actions should be initiated:

1. Replace missing stone, repoint, and reset the stone masonry on the downstream wall and on the cap of the dam as required.

2. Monitor the seepage at the right toe of the dam and determine the source of water on the downstream face. If necessary, seal the upstream face of the dam to prevent further leakage.

3. The stuck gate valve to the low level drain should be tested as soon as weather conditions permit, and if necessary, the control components should be repaired.

c. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam, within one year from the date of approval of this report.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

ROGER L. BALDWIN
Lieutenant Colonel, Corps of Engineers
Commander and District Engineer

1 Incl
As stated

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

STONY LAKE DAM (NJ00263)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 16 January 1981 by Louis Berger and Associates, Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Stony Lake Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. The dam's spillway is considered inadequate because a flow equivalent to 16 percent of the One Hundred Year Flood would cause the dam to be overtopped. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway is inadequate. However, additional hydraulic and hydrological studies are not recommended since the entire dam functions as an overflow weir.

b. Within twelve months from the date of approval of this report the following remedial actions should be initiated:

1. Replace missing stone, repoint, and reset the stone masonry on the downstream wall and on the cap of the dam as required.

2. Monitor the seepage at the right toe of the dam and determine the source of water on the downstream face. If necessary, seal the upstream face of the dam to prevent further leakage.

3. The stuck gate valve to the low level drain should be tested as soon as weather conditions permit, and if necessary, the control components should be repaired.

c. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam, within one year from the date of approval of this report.

APPROVED: Roger Baldwin

ROGER L. BALDWIN
Lieutenant Colonel, Corps of Engineers
Commander and District Engineer

DATE: 22 July 81

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

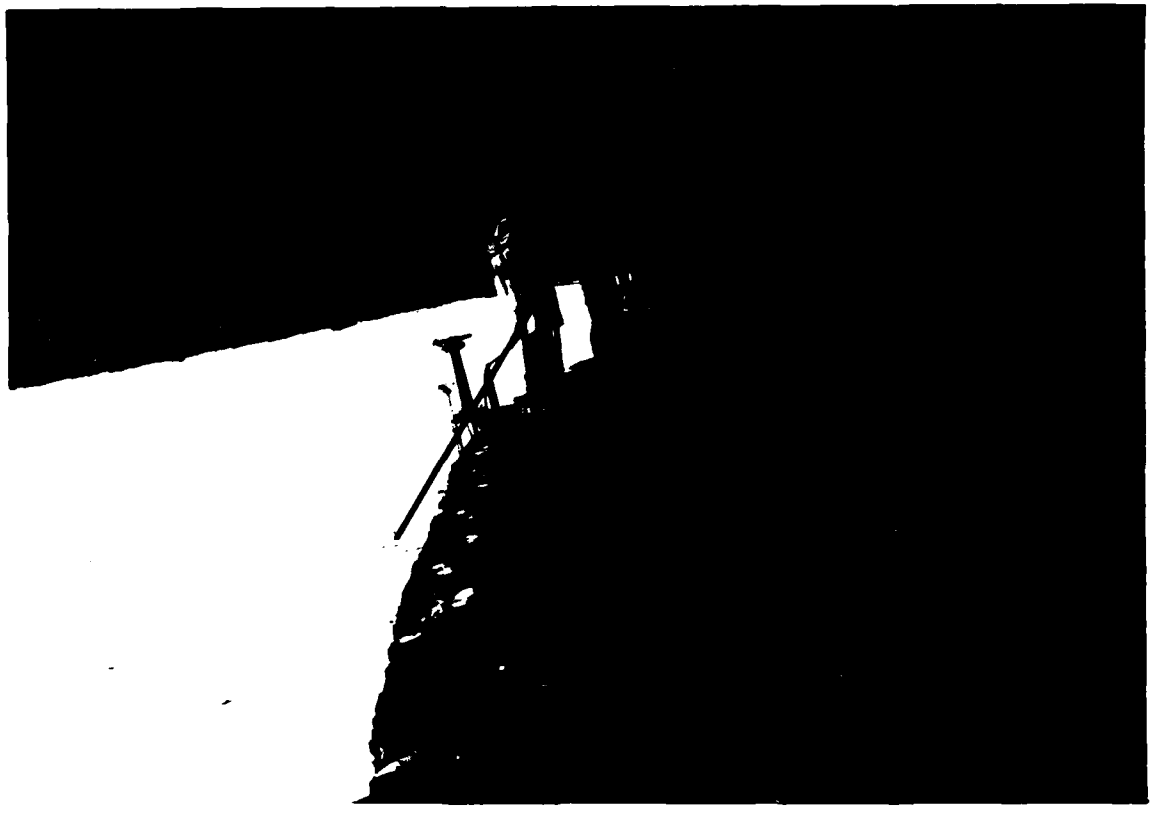
Name of Dam Stony Lake Dam Fed ID# NJ 00263
NJ ID# 21-18

State Located	New Jersey
County Located	Sussex
Coordinates	Lat. 4112.1 - Long. 7446.5
Stream	Stony Brook
Date of Inspection	January 16, 1981

ASSESSMENT OF GENERAL CONDITIONS

Stony Lake Dam is in fair overall condition and it is recommended that the hazard classification be downgraded to the significant category. Although the spillway can only accommodate 15% of the design flood, overtopping should cause no damage to the dam as indicated by historical evidence and stability analysis. Additional hydrologic and hydraulic studies are unwarranted since the entire dam functions as an overflow weir and additional discharge capacity is unnecessary. Recommended remedial action to be undertaken in the future includes replacing the missing stone masonry and repointing deteriorated joints. The gate valve should be tested as soon as possible and repaired if necessary. The seepage at the dam should be monitored and the upstream face resealed if necessary.

Abraham Perera P.E.
Project Manager



OVERVIEW OF STONY LAKE DAM

February, 1981

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines can be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of Phase I investigations is to identify expeditiously those dams that may pose hazards to human life or property. The assessment of the general condition of the dam is based on available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In the review of this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions will be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway test flood is based on the estimated "probable maximum flood" for the region (greatest reasonable possible storm runoff) or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM
NAME OF DAM: STONY LAKE DAM FED #NJ 00263

SECTION 1 PROJECT INFORMATION

1.1 GENERAL

a. Authority

This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with Contract FPM-36 between Louis Berger & Associates, Inc. and the State of New Jersey and its Department of Environmental Protection, Division of Water Resources. The state, in turn, is under agreement with the U.S. Army Engineer District, Philadelphia, to have this inspection performed.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of the Stony Lake Dam and appurtenant structures and to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

Stony Lake Dam is a 142-foot-long, 16.5-foot high cement mortared masonry gravity structure. The structure rests on the shale bedrock and is slightly arched between the bedrock abutments. The upstream face of the dam is vertical, while the downstream face has a 13H to 20V slope. The principal spillway consists of a 25-foot-long, 2.0-foot-deep weir located in the center of the dam. An 18-inch diameter C.I. blow-off pipe is located next to the right end of the spillway at invert elevation 102.0. The gate stem and wheel for the blow-off pipe extends about 3 feet above the dam crest.

b. Location

The dam is located on Stony Brook about a quarter of a mile south of the intersection of Kittle and Coursen roads in Stokes State Forest, Sandyston Township, Sussex County. Access to the dam is possible via Route 206, Kittle Road and the entrance driveway to the Madeleine Mulford Girl Scout Camp.

c. Size Classification

The dam at Stony Lake has a maximum height of 16.5 feet and a maximum storage capacity of 176 acre-feet. Accordingly, this dam is in the small size category as defined by the criteria in the Recommended Guidelines for Safety Inspection of Dams (storage less than 1,000 acre-feet and height less than 40 feet).

d. Hazard Classification

The dam is located in Stokes State Forest, a heavily forested, undeveloped, mountainous portion of Sussex County. The channel immediately below the dam is narrow with relatively steep side slopes. Approximately a quarter of a mile downstream, the channel widens and the stream banks are quite low (less than 3 feet) for another quarter mile. The channel again becomes narrow until it reaches Kittle Road and Big Flat Brook about one mile downstream. While the area below the dam is generally uninhabited, a picnic area is located in the broad area a quarter of a mile downstream, and camping facilities are situated in the vicinity of the Kittle Road, Stony Brook intersection. Moreover, State Forest personnel report that a large number of fishermen may be found along Stony Brook during fishing season. While there are no residences immediately downstream, it is felt that fishermen and/or campers could be endangered should the dam fail, and the loss of a few lives is a definite possibility if dam failure occurs at an inopportune time of the year. Accordingly, it is recommended that this dam be placed in the significant hazard category.

e. Ownership

This dam is owned by the State of New Jersey, Department of Environmental Protection, Bureau of Parks, P.O. Box 1420, Trenton, N.J. 08625.

f. Purpose of Dam

The purpose of the dam is recreation.

g. Design and Construction History

The design and specifications for this dam were prepared in 1926 by John N. Brooks, a hydraulic engineer with the New Jersey State Department of Conservation and Development. Construction began in July 1926 and was completed in October 1926 under the supervision of A.B. Miller of Walter Kidde and Company, Inc., Engineers and Constructors. Several leaks through the dam and foundation were reported by the State Forester in 1928 and the dam was inspected by the Department of Conservation and Development. Waterproofing repairs recommended as a result of that inspection were performed in November of 1929 and consisted of sealing the upstream face of the dam with a tar coating and placing a 4-foot-deep, 5-foot-wide silty clay blanket along the bottom of the reservoir next to the dam. According to state inspection reports dated October 1935, the repairs were successful in sealing the leaks.

h. Normal Operating Procedures

The dam is maintained and operated by personnel of the State Bureau of Parks. Maintenance crews are available all year for routine repairs and upkeep. The lake is normally lowered 5 feet every winter for weed control. This year (1980-1981) drawdown was not performed because of the existing drought conditions prevalent throughout the state. The dam is also monitored by state personnel in the course of their routine duties and, particularly, during periods of abnormally heavy rainfall and runoff.

1.3 PERTINENT DATA

a. Drainage Area

Stony Lake Dam has a drainage area of 1.41 square miles consisting of an undeveloped, heavily forested, mountainous terrain.

b. Total spillway capacity at maximum pool elevation - 212 cfs

c. Elevations (Assumed Datum)

Top of dam	- 116.5
Principal spillway crest	- 114.5
Streambed at centerline of dam	- 100.0

d. Reservoir

Length of maximum pool (top of dam)	- 1,450 feet
Length of recreation pool (principal spillway crest)	- 1,550 feet

e. Storage (acre-feet)

Top of dam - 176±
Recreation pool - 131±

f. Reservoir Surface (acres)

Top of dam - 26.7
Recreation pool - 18.4

g. Dam

Type - Cement mortared masonry arch gravity structure

Length - 142 feet

Height - 16.5 feet

Top width - 2.5 feet

Base width - 13.2 feet

Side Slopes - Upstream vertical; downstream 13H:20V

Zoning - Unzoned

Impervious Blanket - 4-foot-thick silty clay blanket puddled along upstream face of dam in 5-foot swath

Cutoff - Dam extends down to shale bedrock

Grout curtain - None

h. Diversion and Regulating Tunnel

Type - None

i. Spillway

Type - Broad-crested weir in center of dam

Weir Length - 25 feet

Gates - None

U/S Channel - None

D/S Channel - Spillway discharges into natural stilling basin at toe of dam. D/S channel relatively narrow with steep side slopes

j. Regulating Outlets

Low-level drain located at right end of spillway consists of a gate-regulated 18-inch-diameter C.I. pipe at invert elevation 102.0.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

General details of the dam were obtained from a single design drawing dated May 20, 1926. The design drawing was prepared in a manner consonant with contemporary practices and standards but contained few details or particulars of construction. While design calculations and attendant hydraulic and hydrologic design parameters are unavailable, the overall dam geometry is depicted in sufficient detail for the assessment contained herein to be made.

2.2 CONSTRUCTION

The information regarding the construction of the dam can be derived from the 1926 design drawing and from the reports of the New Jersey State Department of Conservation and Development relative to the work performed in 1929 to seal leaks discovered in 1928. Field reconnaisance reveals no deviations from the 1926 design drawings.

2.3 OPERATION

General information pertaining to operational procedures was obtained from the Superintendent of Stokes State Forest, Department of Environmental Protection, Bureau of Parks, Box 260, Branchville, N.J. 07826. The dam is used for recreation purposes only and partial drawdown is effected once a year for maintenance purposes.

2.4 EVALUATION

a. Availability

Sufficient data were obtained from the Department of Environmental Protection, Bureau of Parks, to assess the hydrologic and hydraulic capacity of the reservoir and dam. While complete design data were not available, a stability analysis was done using the original design plans and general geotechnical information obtained from geologic maps for this area. The gravity masonry wall is founded on sedimentary rock belonging to Silurian High Falls formation and consisting of red sandstone and soft

shale facies near the surface. Massive and thin slabby to platy beds are characteristic of the High Falls formation, which at this location dips fairly steeply to the northwest.

b. Adequacy

The original design drawing and general geotechnical information available are felt to be adequate to evaluate the structural aspects of the dam within the purview of Public Law 92-367.

c. Validity

The validity of the engineering data available is not challanged and is accepted without recourse to further investigation.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

Visual inspection of Stony Brook Dam took place on February 5, 1981. Because of low temperatures, the reservoir surface was frozen. However, water was flowing over the spillway, and the downstream face of the dam was adequately visible for the purposes of the field inspection. The dam appears to be in an overall satisfactory condition except as noted hereinafter.

b. Dam

The Dam is a gravity-type masonry structure that closes a 142-foot-wide saddle in the shale bedrock. The end walls of the dam extend 2 feet higher than the crest of the weir and are keyed into the bedrock sidewalls. The bedrock footings show no visible signs of cracking or deterioration, although some leakage was noted in a shallow swale that extends from the right abutment into the spillway channel. Some spalling and cracking of the mortared dam crest surface was noted on both crest walls. The cap stonework on the 25-foot-long weir appears smooth, well joined, and in a generally good condition. The sloped alignment of the downstream face of the dam appears uniform, although the uneven flow down the irregular cut, step-like masonry blocks tended to accentuate the roughness. An occassional block and the mortar joints between some of the stone were missing and should be replaced and repointed. Most of the downstream toe is concealed from view either by boulders or earth deposited along the toe of the wall. The upstream face is vertical. The reservoir bottom near the ends of the weir is approximately 11 feet below the weir surface. The plan alignment of the dam is a 220-foot radius arch. The curvature of the dam appears to be uniform and in conformance with the design plan geometry, and no evidence was noted of any movement of the dam or spillway crest.

c. Appurtenant Structures

Drawdown at this dam is provided by a gate-operated 18-inch-diameter C.I. blow-off pipe located just to the right of the spillway weir at an invert about 14.5 feet below the dam crest. While the wheel, stem, and outlet pipe all appeared in satisfactory condition, the valve or stem is either frozen or rusted shut since the park rangers report it was inoperable when they tested it last fall. There appears to be a natural stilling basin or pond about 30 feet downstream of the dam's toe. The pond, which serves to reduce the erosion force of the dam's discharge, is clear and unobstructed with stable banks and bedrock sidewalls.

d. Reservoir Area

As part of Stokes State Forest, the reservoir area and watershed is protected against development and the lake is completely surrounded by mountainous forests. As a result, the lake and its densely wooded shorelines are in a relatively pristine state, being utilized solely as summer recreational facilities for the Madeleine Mulford Girl Scout Camp.

e. Downstream Channel

The area downstream of the dam is heavily wooded and completely undeveloped as far as the intersection of Flat Brook and Kittle roads. While the channel is generally narrow with steep banks and valley walls, it widens for a short distance about a quarter of a mile downstream. The channel is generally clear, although boulder strewn, and has an average gradient of 5 percent between the dam and the confluence of Stony Brook and Big Flat Brook. Kittle Road intersects the channel 400 feet downstream of the dam. The 6.5 foot x 6.5 foot clear opening of the bridge provides little more than a temporary constraint to flow since the roadway would be overtopped in a very short time during flood flows because of the steep and high stream banks.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Stony Lake Dam functions essentially unregulated throughout most of the year. Personnel of the State Bureau of Parks, who are responsible for the upkeep and maintenance of the dam, lower the lake 5 feet every winter to help control weed growth in the lake and minimize ice damage to the dam and the Girl Scout facilities at the lake. Park personnel also lower the water level during periods of heavy runoff and inflow to the lake.

4.2 MAINTENANCE OF DAM

The repair and maintenance of the dam is performed by personnel of the State Bureau of Parks. They are responsible for all facets of the dam's upkeep including the drain and its controls, fencing, concrete and masonry repairs, sedimentation control, and landscaping. The dam is routinely monitored by maintenance personnel and forest rangers, which facilitates corrective action when deficiencies are noted.

4.3 MAINTENANCE OF OPERATING FACILITIES

The only regulating component at this dam is the 18-inch-diameter C.I. drain. As indicated in paragraph 4.2 above, park maintenance personnel are responsible for its maintenance. At the time of inspection, the stem and wheel, although chained shut, appeared in very good condition. Park personnel indicate that the valve was frozen or jammed when they last attempted to open it. Since the lake was not to be lowered because of the drought conditions, it is possible that the valve mechanism merely froze shut before the park personnel tested it late in the year (1980). Additional testing of this component is scheduled to be performed as soon as the lake thaws, and repairs, if necessary, will be made at that time.

4.4 DESCRIPTION OF WARNING SYSTEM

The dam is monitored by state maintenance personnel and forest rangers in the course of their routine

duties and during periods of abnormally heavy rainfall and runoff, at which time all dams in the State Forest are checked for possible problems. If a potentially hazardous condition is observed at Stony Lake Dam, the inspecting personnel are instructed to radio a report to headquarters and proceed to the downstream picnic areas and campgrounds to start evacuation procedures.

4.5 EVALUATION

The operational and maintenance procedures in effect at this dam are felt to be adequate within the framework of its limited requirements. The emergency action plans and warning procedures in effect at this dam are considered adequate in view of the undeveloped nature of the downstream area.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data

Pursuant to the Recommended Guidelines for Safety Inspection of Dams, Stony Lake Dam is a small size and significant hazard. Accordingly, the 100-year frequency storm was chosen as the design flood by the inspecting engineers. Inflow to the reservoir for the selected storm was computed utilizing precipitation data from Technical Paper 40, Technical Memorandum NWS HYDRO-35, and the HEC-1 Dam Safety Version computer program, which gave a peak inflow of 1,666 cfs. Routing this storm through the reservoir reduced the peak discharge to 1,379 cfs. As the spillway capacity is 212 cfs, it can accommodate only 15 percent of the 100-year storm.

b. Experience Data

There are no streamflow records available for this site. However, there are records that indicate that the dam was overtopped by 6 inches of water on September 21, 1938. The gate valve was opened and the lake level lowered by the morning of September 22, 1938. There are no indications that the overtopping resulted in damage to the dam or downstream rea.

c. Visual Observations

There is no evidence of recent problems. The lake level was at normal pool elevation at the time of inspection.

d. Overtopping Potential

Employing the discharge and spillway capacities contained herein, overtopping of 1.7 feet would occur in the event of the 100-year frequency storm. In view of the limited capacity of the spillway (15 percent of 100-year storm), it is possible the dam has been overtopped on more than one occasion, although there are no substantiating records available.

e. Drawdown

An 18-inch-diameter CI pipe controlled by a gate valve is used for drawdown. It would take 3.9 days to drawdown to elevation 102.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

Based on the field inspection and a cursory static overturning analysis, Stony Lake Dam is considered to be in a satisfactory structural condition commensurate with its age, but it is believed that the jointery in the stone masonry should be repointed. The crest of the dam appears to be quite level, exhibiting no deviation from a horizontal plane. Similarly, the spillway has a very even, horizontal crest, as indicated by the discharge, which was flowing uniformly, 1-inch deep, over the entire weir. The downstream slope of the dam, while constructed of stepped blocks, appears to have a uniform overall batter and arch as originally designed. Wear and surface weathering, consonant with the age of the stonework, was noted on the exposed rounded edges of the blocks, but this is not a concern with respect to the structural integrity of the dam. However, in those areas where an isolated stone is missing from the face and crest of the dam, the block should be replaced when the repointing work is undertaken.

Although the dam's bedrock foundation appears to be quite stable, seepage was noted at the juncture of the dam face and the bedrock beginning at a point about 20 feet from the right abutment. It is difficult to ascertain whether the seepage is emanating from between the base of the dam and the bedrock or along bedding planes/joints in the bedrock. Since ground water, in the form of ice, was observed flowing from bedding planes in the shale bedrock wall of the channel immediately below the left side of the spillway, it is possible that the seepage at the right abutment may originate in the same manner. The presence of ice across the entire face of the dam is also somewhat of an engima. It could be due to spray from the spillway or to seepage through the dam itself. Both of the conditions described above should be monitored, and if it is determined that they are directly attributable to dam leakage, appropriate corrective action should be taken to seal the upstream face and/or toe of the dam.

b. Design and Construction Data

Design calculations and the orignal stability analyses were not available, but the wall section appears to have an adequate factor of safety against sliding and overturning. A single 1926 drawing containing a plan view, section, and profile of the dam was available for review by the inspection team and appeared to represent an accurate depiction of the dam as built. In addition, engineering correspondence describing conditions and events during the construction period indicate that the dam's design conformed to conservative standards and that the construction was well supervised and performed in a diligent and proper manner. Nothing was observed during the dam inspection to belie these impressions.

c. Operating Records

No records or logs are maintained at this reservoir for operations other than occasional routine groundkeeping or maintenance.

d. Post Construction Changes

The only post construction work performed at this dam involved sealing the upstream face of the dam with a bituminous coating and placing a 5-foot-wide impervious blanket along the upstream toe. Both "repairs" were performed two years after the dam was built in order to reduce dam seepage. The measures appear to have been successful, according to subsequent inspection reports. No changes of a structural nature have been made since this dam was constructed.

e. Seismic Stability

This dam is located in Zone 1, and because of its geometry and size, it is only negligibly vulnerable to earthquake forces. Experience indicates that dams in Zone 1 will be adequately stable under dynamic loading conditions if they are stable under static loading conditions. A cursory stability analysis indicated that this dam is stable under static loading conditions and that it has adequate factors of safety against overturning and sliding.

SECTION 7 - ASSESSMENTS/RECOMMENDATIONS/ REMEDIAL ACTIONS

7.1 DAM ASSESSMENT

a. Safety

Stony Lake Dam appears to be in a fair overall condition, and except for some deterioration of the stone masonry joints, it exhibits few signs of deterioration in spite of its 55 years of existence. Its spillway is incapable of transmitting the design discharge without overtopping, and there are reports that the entire dam was, in fact, overtopped by 6 inches of water in September of 1938 with no damage resulting therefrom. Although the dam has adequate safety factors against sliding or overturning, it is noted that it has a substantial structural height, and the inspection team believes it prudent for the state's personnel to continue to closely monitor the dam's condition until an in-depth inspection of the condition of the stone masonry and seepage is performed. However, within the visual inspection limitations inherent in the procedures stipulated by the Phase I criteria of the Corps of Engineers, the dam is believed to be in adequate condition if the monitoring and remedial measures set forth below are undertaken.

b. Adequacy of Information

While the information available to evaluate the hydraulic and hydrologic capabilities of the reservoir was adequate, the lack of design data precluded a definitive evaluation of the structural stability except for what could be visually observed. However, the available data are felt to be adequate for the Phase I assessment.

c. Urgency

Remedial measures described below can be undertaken in the future as part of the regular maintenance program by personnel of the State's Bureau of Parks.

d. Necessity for Further Studies

Further studies are believed to be unnecessary under the purview of Public Law 92-367 because the State Department of Environmental Protection, Bureau of Parks, has experienced engineering personnel who maintain an internal system of inspections and action plans that basically reflect the requirements mandated under the Dam Inspection Act.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

a. Recommended Actions

1. Replace missing stone, repoint, and reset the stone masonry on the downstream wall and on the cap of the dam as required.

2. Monitor the seepage at the right toe of the dam and determine the source of water on the downstream face. If necessary, seal the upstream face of the dam to prevent further leakage.

3. The stuck gate valve to the low level drain should be tested as soon as weather conditions permit, and if necessary, the control components should be repaired.

b. O&M Maintenance and Procedures

Although the present O&M procedures employed at the dam are adequate to accommodate routine situations, it is recommended that the owner develop a formal periodic inspection and complementary maintenance plan whereby repair of potentially critical deficiencies can be expedited should the need occur. The existing monitoring and emergency alert plan appears adequate in view of the undeveloped nature of the downstream area.

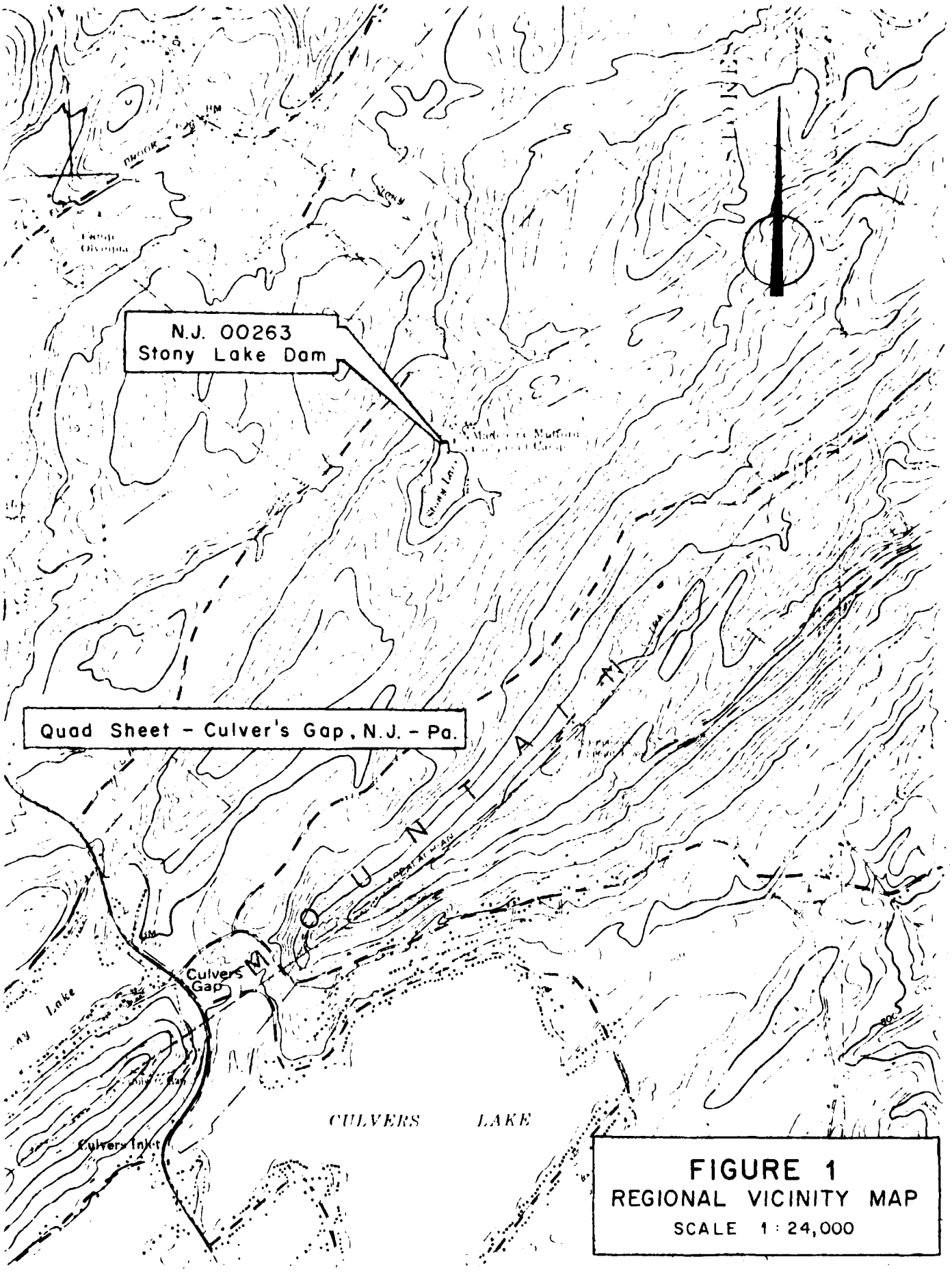
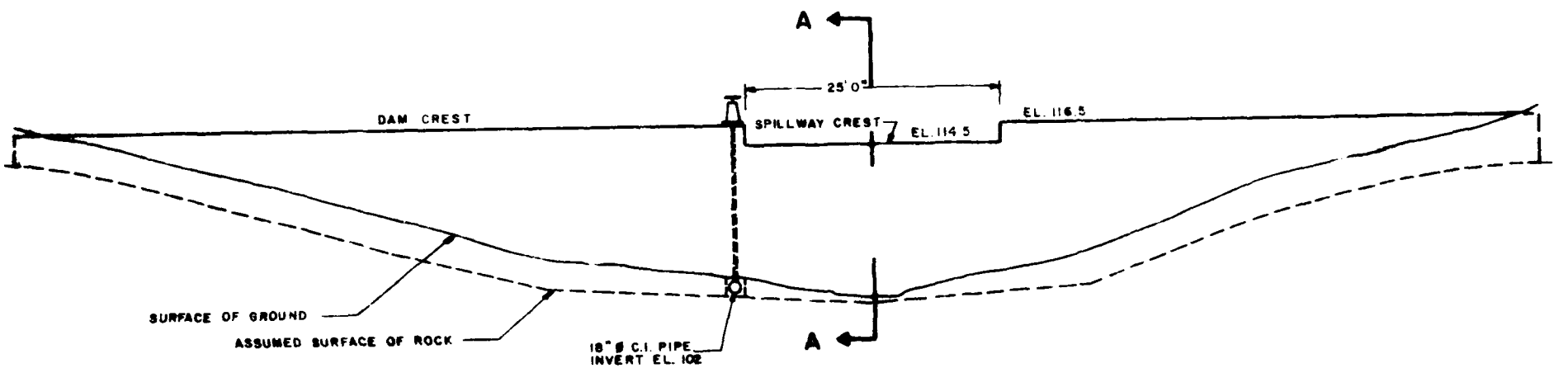


FIGURE 1
REGIONAL VICINITY MAP
SCALE 1 : 24,000

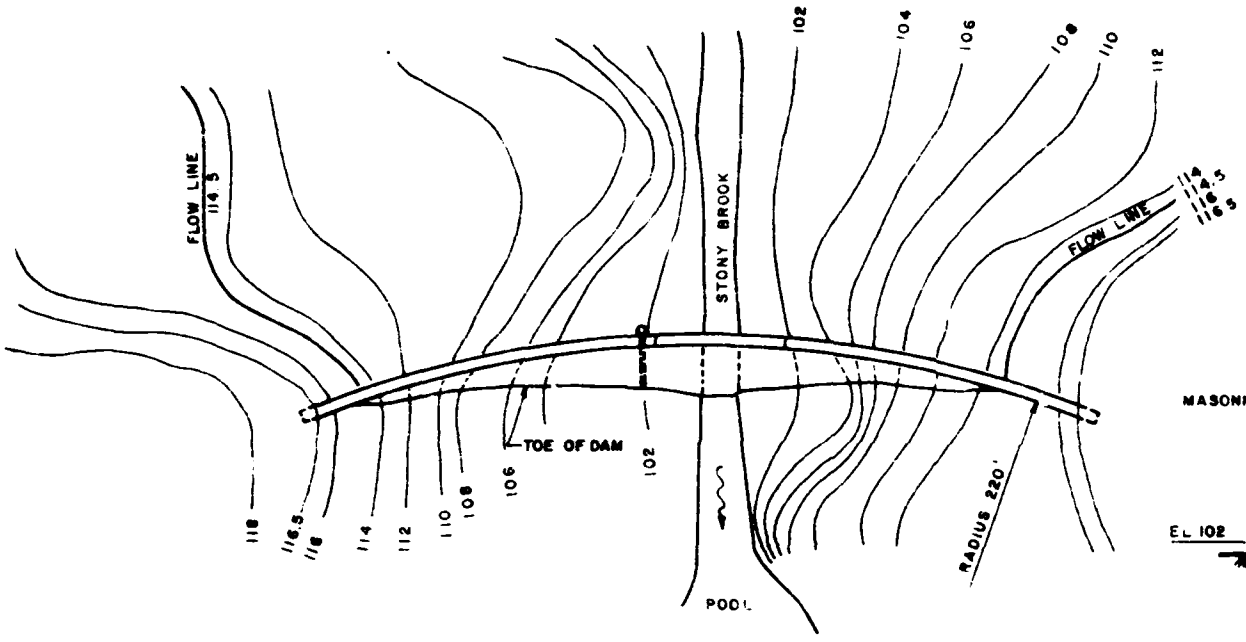


ELEVATION LOOKING UPSTREAM

NOT TO SCALE

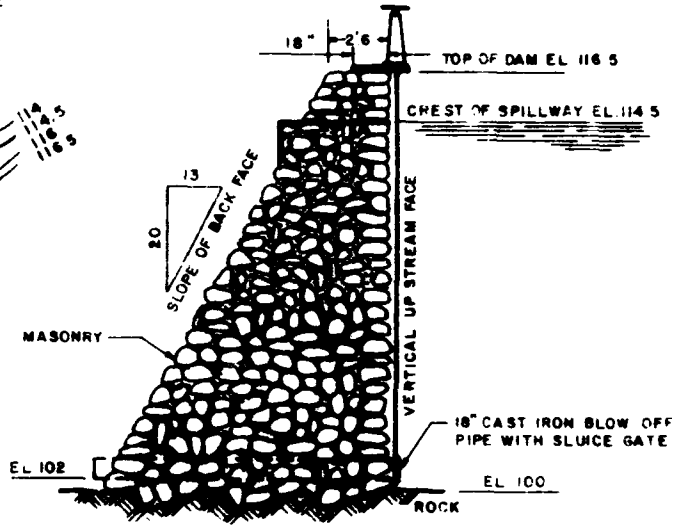
Source:
New Jersey Dept. of Cons. & Devel.

STONY LAKE DAM
FIGURE 2



PLAN OF DAM

NOT TO SCALE



SECTION A-A

NOT TO SCALE

Source:
New Jersey Dept. of Cons. & Devel.

STONY LAKE DAM
FIGURE 3

Check List
Visual Inspection
Phase 1

Name Dam Stony Lake Dam County Sussex State New Jersey Coordinators NJDEP

Date(s) Inspection 1/16/81 & 2/5/81 Weather Clear & Cold Temperature 20°F

Pool Elevation at Time of Inspection 114.5 A.D. Tailwater at Time of Inspection 100 A.D.

Inspection Personnel:

T. Chapter J. Greenstein

J. Ceravolo

A. Perera

J. Ceravolo Recorder

No owners representative present.

A.D. - Assumed Datum

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEEPAGE OR LEAKAGE	Groundwater coming from bedding planes in shale at left abutment. Much of downstream face of dam covered with ice. Seepage at junction of toe of dam and right bedrock foundation. Possible seepage through masonry joints at several locations.	All seepage should be monitored to determine source. If seepage originates through or under dam, leaks should be sealed from upstream side.
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Good condition. No cracking or movement observed.	
DRAINS	None	
WATER PASSAGES	Spillway notch in satisfactory condition.	
FOUNDATION	Built on shale bedrock.	Shale dips to the northwest. Appears stable, although groundwater movement through bedding planes noted in downstream abutment area.

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Could not be seen on downstream side. Mortar spalled and cracked on top two feet of upstream face of dam. Some masonry blocks missing from top wall.	Missing masonry blocks should be replaced, joints repointed, and spalled mortar replaced or repaired. Upstream surface appears covered with weathered bituminous layer.
STRUCTURAL CRACKING	None observed	
VERTICAL AND HORIZONTAL ALIGNMENT	Appears uniform. No movement, settlement, or displacement observed.	
MONOLITH JOINTS	Joints between many of the individual lithologic blocks in need of repointing. Some weathering and rounding of individual blocks.	Weathering surface of stone of no structural consequence.
CONSTRUCTION JOINTS	Not Applicable	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None Observed	
INTAKE STRUCTURE	Not Observed	
OUTLET STRUCTURE	None	
OUTLET CHANNEL	Discharges into main spillway stilling basin.	
EMERGENCY GATE	Frozen shut and inoperative at present time according to state personnel.	Only drawdown facility. Must be repaired if still inoperative after thaw.

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Light spalling on crest.	1 inch of water flowing uniformly over weir. Spalled areas should be resurfaced
APPROACH CHANNEL	None	
DISCHARGE CHANNEL	Discharges directly into small natural stilling basin at toe of spillway.	Surrounded by bedrock on sides.
BRIDGE AND PIERS	None	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Heavily wooded, uninhabited state forest. Slopes generally steep going away from the reservoir (25^{o}-30^{o}).	Lake completely frozen over to depth of 12 inches per forest ranger and park personnel.
SEDIMENTATION	According to park personnel, the lake is heavily silted near the dam. However, a rod lowered through a hole in the ice showed the bottom of the lake to be 11 feet below the spillway crest.	Further spot checks for siltation should be made by park personnel when the ice thaws.

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Narrow channel 12'-15' wide. Small road bridge about 400' downstream clear opening is 6.5'x6.5'. Channel width about 12'.	Bridge is no constriction to flood flow since the access road is low and would be rapidly overtopped.
SLOPES	Right Slope - 1.5:1 Left Slope - 2.5:1	
APPROXIMATE NO. OF HOMES AND POPULATION	No homes. Campsite about 5900 feet downstream. Picnic ground about 2000 feet below dam.	Downstream channel heavily fished in season.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Available NJDEP Microfilm - NJDEP, Prospect Street, Trenton, New Jersey
REGIONAL VICINITY MAP	Available - U.S.G.S. Quandrangle - Culvers Gap, N.J.
CONSTRUCTION HISTORY	Available - NJDEP microfilm
TYPICAL SECTIONS OF DAM	Available - NJDEP microfilm
HYDROLOGIC/HYDRAULIC DATA	Available - NJDEP microfilm
OUTLETS - PLAN	Available - NJDEP microfilm
- DETAILS	Not Available
-CONSTRAINTS	Not Available
-DISCHARGE RATINGS	Available - NJDEP microfilm
RAINFALL/RESERVOIR RECORDS	Not Available

ITEM	REMARKS
SPILLWAY PLAN	Available, NJDEP microfilm
SECTIONS	Available, NJDEP microfilm
DETAILS	Not Available
OPERATING EQUIPMENT	Not Available
PLANS & DETAILS	Not Available

ITEM	REMARKS
DESIGN REPORTS	Not Available
GEOLOGY REPORTS	Not Available
DESIGN COMPUTATIONS	Available NJDEP microfilm
HYDROLOGY & HYDRAULICS	Available NJDEP microfilm
DAM STABILITY	Not Available
SEEPAGE STUDIES	Not Available
MATERIALS INVESTIGATIONS	Not Available
BORING RECORDS	Not Available
LABORATORY	Not Available
FIELD	Not Available
POST-CONSTRUCTION SURVEYS OF DAM	Not Available
BORROW SOURCES	Not Available

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	
HIGH POOL RECORDS	None Available
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Not Available
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None, although dam overtopped by 0.5-feet in 1938. Description of event available in NJDEP Microfilm. No damage reported.
MAINTENANCE OPERATION RECORDS	No records available

February, 1981

Spillway Looking Downstream

February, 1981

Spillway Looking Upstream

January, 1981

Road Bridge 400' Downstream

January, 1981

View of Crest Wall Deterioration

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 1.41 sq. mi.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 114.5 AD (131± acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N/A

ELEVATION MAXIMUM DESIGN POOL: 115.5 AD

ELEVATION TOP DAM: 116.5 AD (176± acre-feet)

CREST: Spillway

a. Elevation 114.5 AD
b. Type Broad crested weir
c. Width 2.5 feet
d. Length 25 feet
e. Location Spillover Center of dam
f. Number and Type of Gates None

OUTLET WORKS:

a. Type 18"-dia. C.I. Pipe
b. Location Right end of spillway weir
c. Entrance inverts 102 AD
d. Exit inverts 102 AD
e. Emergency draindown facilities Same

HYDROMETEOROLOGICAL GAGES: None
a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 212 cfs

AD - Assumed Datum

BY _____ DATE 1-12-83

CHKD. BY _____ DATE _____

SUBJECT _____

LOUIS BERGER & ASSOCIATES INC.

Stony Lake Dam

Time Of Concentration

SHEET NO A1 OF 414

PROJECT CC-276

1.- Length along watercourse = 8850 ft. (1.68 mi)

ΔH = 417 ft. - Slope = $\frac{417 \times 100}{8850'}$ = 4.7 %

Assume channel velocity of 4 fps $\therefore t_c = \frac{8850}{4 \times 3600}$ = 0.62 hrs.

Length of overland flow = 3350 ft. (0.63 mi)

ΔH = 130 ft - Slope = $\frac{130' \times 100}{3350'}$ = 3.9 %

Assume overland velocity = 2 fps $\therefore t_c = \frac{3350}{2 \times 3600}$ = 0.47 hrs.

Total t_c = 0.62 + 0.47 = 1.09 hrs.

2.- California Culverts Methodology

Watercourse $t_c = \left(\frac{11.9 \times 2.31^3}{547}\right)^{0.385}$ = 0.6 hrs. Overland t_c = .47 hrs

Total t_c = 1.07 hrs

3.- SCS Methodology

Assume Cn for watershed = 55

Dutchess, Dover, Gloucester, Lackawanna, Fox soils - All Group B

100 % wooded uplands (Cn = 55)

Slope = 4.5 %

l = 12200 ft.

$Lag = \frac{l^{0.8} \times (S+1)^{0.7}}{1900\, y^{0.5}} = \frac{12200^{0.8} \times 9.18^{0.7}}{1,900 \times 4.5^{0.5}}$ = 2.18 hrs.

t_c = Lag / 0.6 = 3.63 hrs.

Avg. $t_c = \frac{1.09 + 1.07 + 3.63}{3}$ = 1.93 hrs.

$T_p = D/2 + 0.6\, t_c$ = 0.25/2 + 0.6 (1.93) = 1.283 hrs

BY J.C DATE 1-12-81 | **LOUIS BERGER & ASSOCIATES INC.** | SHEET NO A2 OF A14

CHKD. BY DATE | Stony Lake Dam | PROJECT CC-276

SUBJECT Unitgraph

$$q_p = \frac{484\ (1.41)\ 1.0}{1.283} = 532 \text{ cfs for } 1'' \text{ of runoff}$$

Unitgraph Time (Hrs)	T/Tp	Dimensionless Ordinate (D.O.)	Q (cfs) (q_p x D.O.)
0.25	0.19	.069	37
0.50	0.39	.268	196
0.75	0.58	.566	301
1.00	0.78	.766	421
1.25	0.97	.991	527
1.50	1.17	.1[illegible]	477
1.75	1.36	.[illegible]86	415
2.00	1.56	.60	319
2.25	1.75	.4[illegible]	242
2.50	1.95	.245	134
2.75	2.14	.264	140
3.00	2.34	.198	105
3.25	2.53	.1475	78
3.50	2.73	.1092	58
3.75	2.92	0842	45
4.00	3.12	.0656	35

$$\text{Check } \frac{3645 \times 12 \times 3600}{4 \times 1.41 \times 5280^2} = 1.01 \text{ INCH}$$

BY _____ DATE JUNE '81 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO A3 OF A14

CHKD. BY _____ DATE _____ STONY LAKE DAM PROJECT CC 276

SUBJECT _____ TEST STORM: 100 YEAR FREQUENCY

Precipitation data from TP-40 & NOAA Technical Memorandum NWS Hydro-35

Time	Precipitation	Δ	Rearranged Δ
0.25	1.60	1.60	0.06
0.50	2.30	0.64	0.07
0.75	2.70	0.40	0.07
1.00	3.00	0.30	0.08
1.25	3.25	0.25	0.09
1.50	3.44	0.19	0.10
1.75	3.60	0.16	0.11
2.00	3.75	0.15	0.13
2.25	3.89	0.14	0.15
2.50	4.02	0.13	0.19
2.75	4.14	0.12	0.30
3.00	4.25	0.11	0.64
3.25	4.35	0.10	1.66
3.50	4.45	0.10	0.00
3.75	4.54	0.09	0.25
4.00	4.63	0.09	0.16
4.25	4.71	0.08	0.14
4.50	4.79	0.08	0.12
4.75	4.87	0.08	0.10
5.00	4.94	0.07	0.09
5.25	5.01	0.07	0.08
5.50	5.08	0.07	0.08
5.75	5.14	0.06	0.07
6.00	5.20	0.06	0.06

BY _____ DATE 1-12-81

CHKD. BY _____ DATE _____

SUBJECT _____

LOUIS BERGER & ASSOCIATES INC.

Stony Lake Dam

Stage Discharge

SHEET NO A4 OF A14

PROJECT CC-276

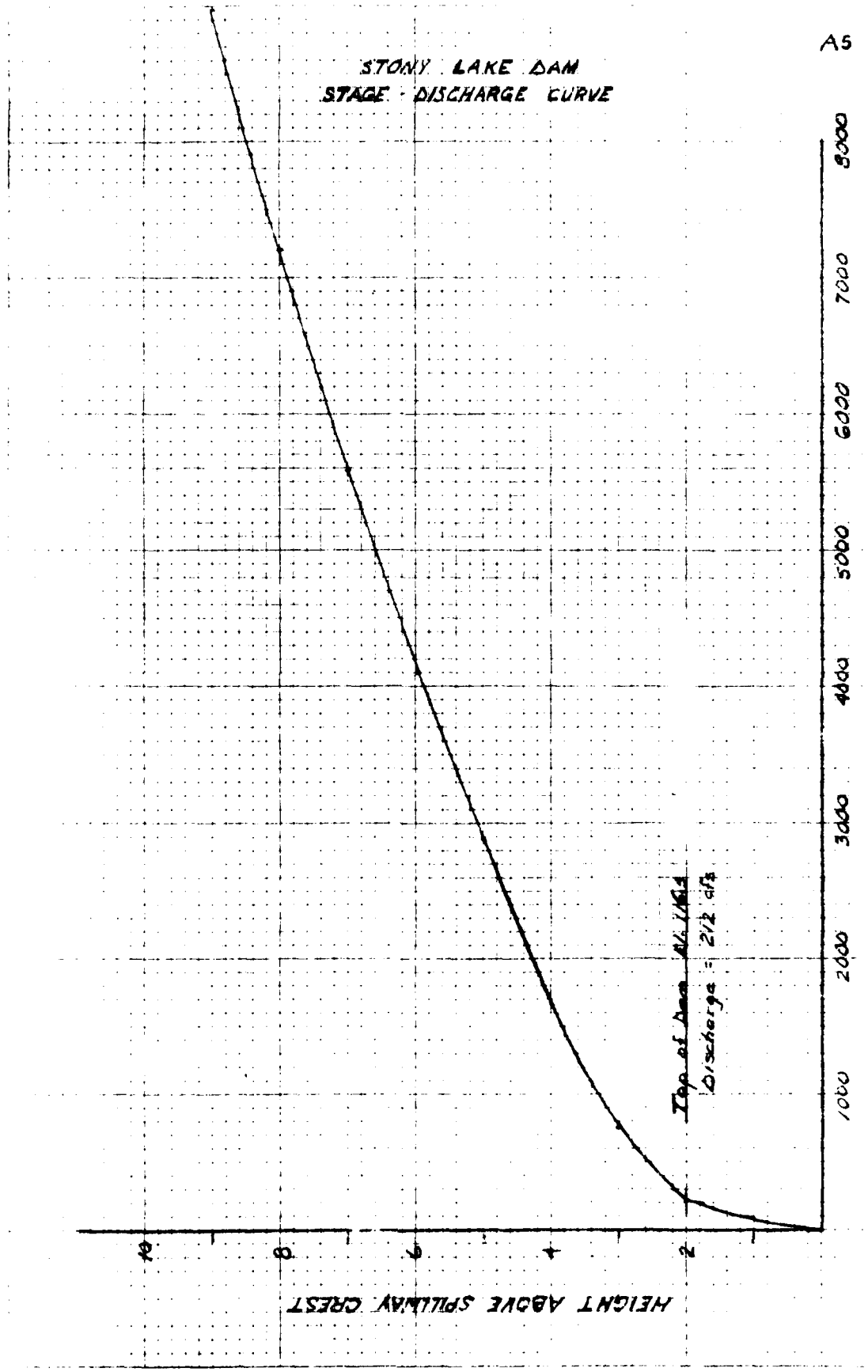
$Q = CLH^{3/2}$

Flow over Spillway Crest
El. 114.5* - L = 25'

Flow over Dam
Elev. 116.5* - L = 125'

H	C	Q	H	C	Q	ΣQ
0	3.0					
1		75				75
2		212	0	3.0		212
3		390	1		375	765
4		600	2		1,060	1,660
5		839	3		1,949	2,788
6		1,102	4		3,000	4,102
7		1,389	5		4,192	5,581
8		1,697	6		5,511	7,208
9		2,025	7		6,945	8,970
10		2,372	8		8,485	10,857

* Assumed datum: El. 115 correlates approx. with 895.0 NGVD


STONY LAKE DAM
STAGE - DISCHARGE CURVE
HEIGHT ABOVE SPILLWAY CREST
10
8
6
4
2
1000
2000
3000
4000
5000
6000
7000
8000
DISCHARGE IN CFS
Top of Dam 4½ (Max)
Discharge = 2½ cfs

BY _____ DATE 1-12-81
CHKD. BY _____ DATE _____
SUBJECT _____

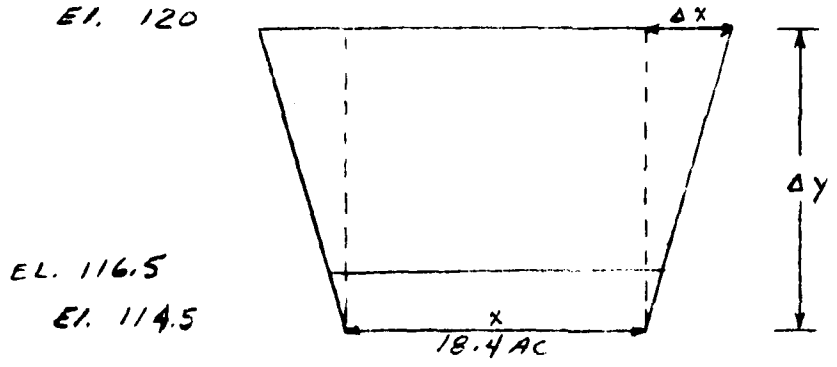
LOUIS BERGER & ASSOCIATES INC.

Stony Lake Dam
Surcharge Storage

SHEET NO A6 OF A14
PROJECT CC-276

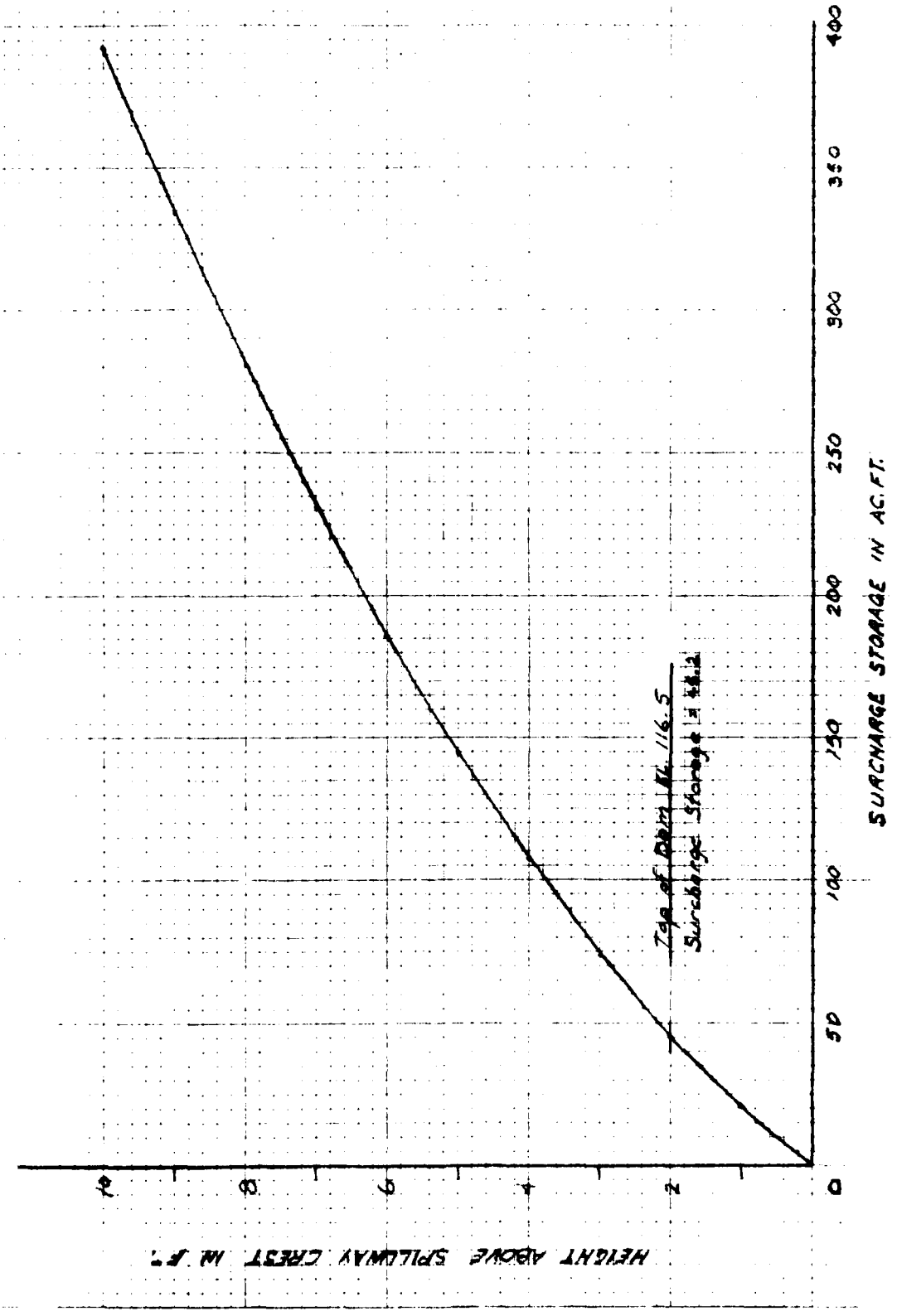
Area at lake at el. 114.5 A.D. = 18.4 ac.
Area at 900' contour (120 A.D.) = 41.3 ac.

Δ Surcharge Storage = $\Delta y\ (x + \Delta x)$



Elev.	Ht. above Spillway (Δy in ft)	($x + \Delta x$) (ac.)	Surcharge Storage (ac. ft)	TOTAL STORAGE (ac. ft.)
102	—	—	—	0
114.5	0	18.4	0	130.9
115.5	1	20.5	20.5	151.4
116.5	2	22.6	45.2	176.1
117.5	3	24.6	73.8	204.7
118.5	4	26.7	106.8	237.7
119.5	5	28.8	144	274.9
120.5	6	30.9	185.4	316.3
121.5	7	33.0	231	361.9
122.5	8	35.1	280.8	411.7
123.5	9	37.1	333.9	464.8
124.5	10	39.2	392.0	522.9

STONY LAKE DAM
STAGE - SURCHARGE STORAGE CURVE



BY _____ DATE 1-12-81

CHKD. BY _____ DATE _____

SUBJECT _____

LOUIS BERGER & ASSOCIATES INC.

Stony Lake Dam

Summary For HEC-1 Input

SHEET NO. A8 OF A14

PROJECT 66-276

ELEV	Ht. above Splwy. Crest (ft)	Surcharge Storage (ac.ft)	Discharge (cfs)
114.5	0	0	0
115.5	1	20.5	75
116.5	2	45.2	212
117.5	3	73.8	765
118.5	4	106.8	1,660
119.5	5	144	2,788
120.5	6	185.4	4,102
121.5	7	231	5,581
122.5	8	280.8	7,208
123.5	9	333.9	8,970
124.5	10	392.0	10,857

BY_____ DATE 1-12-81
CHKD. BY_____ DATE_____
SUBJECT_____

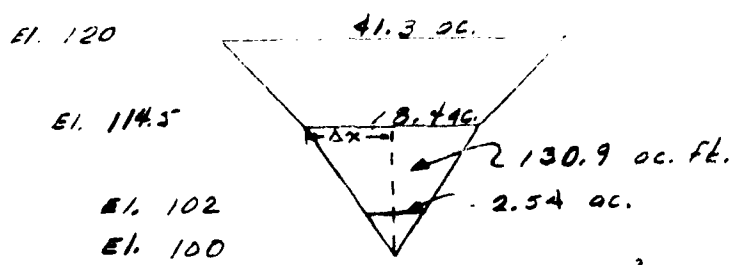
LOUIS BERGER & ASSOCIATES INC.

Stony Lake Dam
Drawdown Analysis

SHEET NO. A9 OF A14
PROJECT 66-276

Drawdown by 18 C.I pipe : Invert el. - 102.0

Assume area of lake at elevation 100.0 essentially 0.0 acres. ∴ $2\Delta x = 1.269$ ac./ft.



Assume inflow of 1 cfs per mi.^{2} of D.A. ∴ inflow = 1.4 cfs

$Q = CA\sqrt{2gH}$ $\quad C = .55$

$A = 1.77$

head at top of pipe $\quad H = 11.0' \quad H_{avg.} = 5.5'$

$Q = 0.55\ (1.77)\sqrt{2 \times 32.2 \times 5.5} = 18.3$ cfs - inflow

$Q = 18.3 - 1.4 = 16.9$ cfs

$$\text{Drawdown time} = \frac{130.9 \text{ ac. ft} \times 43{,}560 \text{ ft/ac}}{16.9 \times 3600} = 93.7 \text{ hrs}$$

Say 3.9 days to draw down to el. 102.

BY J.C DATE 6/2/81

CHKD. BY DATE

SUBJECT STONY LAKE DAM

LOUIS BERGER & ASSOCIATES INC.

SHEET NO A 12 OF A 14

PROJECT CC 2776

```
A1  STONY LAKE DAM HEC1DB
A2  J  CERAVOLO
A3  MARCH 5, 1981
B     100       0      15       0       0       0       0       0       0       0
B1      3
K       0       1                                       1
K1  INFLOW HYDROGRAPH TO RESERVOIR
M       0      -1    1.41
O      24
O1    .06     .07     .07     .08     .09     .10     .11     .13     .15     .19
O1    .30     .64    1.66     .40     .25     .16     .14     .12     .10     .09
O1    .08     .08     .07     .06
T                                                       .5      .1
U      16
U1     37     196     301     461     527     499     418     319     242     184
U1    140     105      78      58      45      35
X       0       0       1
K       1       2                                       1
K1  ROUTED FLOWS THROUGH RESERVOIR
Y                               1       1
Y1      1                                               -1
Y4  114.5   115.5   116.5   117.5   118.5   119.5   120.5   121.5   122.5
Y5      0      75     212     765    1660    2788    4102    5581    7208
$S      0    20.5    45.2    73.8   106.8     144   185.4     231   280.8
$E  114.5   115.5   116.5   117.5   118.5   119.5   120.5   121.5   122.5
$$  114.5
$D  116.5
K      99
```

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
100	0	15	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
3	0	0	0

INFLOW HYDROGRAPH TO RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDQ	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	-1	1.41	0.00	1.41	0.00	0.000	0	0	0

PRECIP PATTERN

0.06	0.07	0.07	0.08	0.09	0.10	0.11	0.13	0.15	0.19
0.30	0.64	1.66	0.40	0.25	0.16	0.14	0.12	0.10	0.09
0.08	0.08	0.07	0.06						

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	0.50	0.10	0.00	0.00

SUB-AREA RUNOFF COMPUTATION

PRECIP DATA

NP	STORM	DAJ	DAK
24	0.00	0.00	0.00

GIVEN UNIT GRAPH, NUHGG= 16

37.	196.	301.	461.	527.	499.	418.	319.	242.	184.
140.	105.	78.	58.	45.	35.				

UNIT GRAPH TOTALS 3645. CFS OR 1.00 INCHES OVER THE AREA

RECESSION DATA

STRTQ= 0.00 QRCSN= 0.00 RTIOR= 1.00

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
**********	**********	**********	**********	**********

HYDROGRAPH ROUTING

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	-1

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME

BY J. C. DATE [illegible] **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A11 OF A14

CHKD. BY ____ DATE ____ [illegible] PROJECT QC 276

SUBJECT ____

0 MO. DA	HR. MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	MO. DA	HR. MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	0.15	1	0.06	0.00	0.06	0.	1.01	12.45	51	0.00	0.00	0.00	0.
1.01	0.30	2	0.07	0.00	0.07	0.	1.01	13.00	52	0.00	0.00	0.00	0.
1.01	0.45	3	0.07	0.00	0.07	0.	1.01	13.15	53	0.00	0.00	0.00	0.
1.01	1.00	4	0.08	0.00	0.08	0.	1.01	13.30	54	0.00	0.00	0.00	0.
1.01	1.15	5	0.09	0.00	0.09	0.	1.01	13.45	55	0.00	0.00	0.00	0.
1.01	1.30	6	0.10	0.00	0.10	0.	1.01	14.00	56	0.00	0.00	0.00	0.
1.01	1.45	7	0.11	0.06	0.05	2.	1.01	14.15	57	0.00	0.00	0.00	0.
1.01	2.00	8	0.13	0.10	0.03	16.	1.01	14.30	58	0.00	0.00	0.00	0.
1.01	2.15	9	0.15	0.12	0.03	44.	1.01	14.45	59	0.00	0.00	0.00	0.
1.01	2.30	10	0.19	0.16	0.03	91.	1.01	15.00	60	0.00	0.00	0.00	0.
1.01	2.45	11	0.30	0.27	0.03	161.	1.01	15.15	61	0.00	0.00	0.00	0.
1.01	3.00	12	0.64	0.61	0.03	270.	1.01	15.30	62	0.00	0.00	0.00	0.
1.01	3.15	13	1.66	1.63	0.03	484.	1.01	15.45	63	0.00	0.00	0.00	0.
1.01	3.30	14	0.40	0.37	0.03	859.	1.01	16.00	64	0.00	0.00	0.00	0.
1.01	3.45	15	0.25	0.22	0.03	1185.	1.01	16.15	65	0.00	0.00	0.00	0.
1.01	4.00	16	0.16	0.13	0.03	1523.	1.01	16.30	66	0.00	0.00	0.00	0.
1.01	4.15	17	0.14	0.11	0.03	1666.	1.01	16.45	67	0.00	0.00	0.00	0.
1.01	4.30	18	0.12	0.09	0.03	1613.	1.01	17.00	68	0.00	0.00	0.00	0.
1.01	4.45	19	0.10	0.07	0.03	1434.	1.01	17.15	69	0.00	0.00	0.00	0.
1.01	5.00	20	0.09	0.06	0.03	1208.	1.01	17.30	70	0.00	0.00	0.00	0.
1.01	5.15	21	0.08	0.05	0.02	1006.	1.01	17.45	71	0.00	0.00	0.00	0.
1.01	5.30	22	0.08	0.05	0.02	836.	1.01	18.00	72	0.00	0.00	0.00	0.
1.01	5.45	23	0.07	0.04	0.02	694.	1.01	18.15	73	0.00	0.00	0.00	0.
1.01	6.00	24	0.06	0.03	0.02	574.	1.01	18.30	74	0.00	0.00	0.00	0.
1.01	6.15	25	0.00	0.00	0.00	474.	1.01	18.45	75	0.00	0.00	0.00	0.
1.01	6.30	26	0.00	0.00	0.00	387.	1.01	19.00	76	0.00	0.00	0.00	0.
1.01	6.45	27	0.00	0.00	0.00	311.	1.01	19.15	77	0.00	0.00	0.00	0.
1.01	7.00	28	0.00	0.00	0.00	234.	1.01	19.30	78	0.00	0.00	0.00	0.
1.01	7.15	29	0.00	0.00	0.00	140.	1.01	19.45	79	0.00	0.00	0.00	0.
1.01	7.30	30	0.00	0.00	0.00	97.	1.01	20.00	80	0.00	0.00	0.00	0.
1.01	7.45	31	0.00	0.00	0.00	68.	1.01	20.15	81	0.00	0.00	0.00	0.
1.01	8.00	32	0.00	0.00	0.00	48.	1.01	20.30	82	0.00	0.00	0.00	0.
1.01	8.15	33	0.00	0.00	0.00	33.	1.01	20.45	83	0.00	0.00	0.00	0.
1.01	8.30	34	0.00	0.00	0.00	23.	1.01	21.00	84	0.00	0.00	0.00	0.
1.01	8.45	35	0.00	0.00	0.00	15.	1.01	21.15	85	0.00	0.00	0.00	0.
1.01	9.00	36	0.00	0.00	0.00	10.	1.01	21.30	86	0.00	0.00	0.00	0.
1.01	9.15	37	0.00	0.00	0.00	6.	1.01	21.45	87	0.00	0.00	0.00	0.
1.01	9.30	38	0.00	0.00	0.00	3.	1.01	22.00	88	0.00	0.00	0.00	0.
1.01	9.45	39	0.00	0.00	0.00	1.	1.01	22.15	89	0.00	0.00	0.00	0.
1.01	10.00	40	0.00	0.00	0.00	0.	1.01	22.30	90	0.00	0.00	0.00	0.
1.01	10.15	41	0.00	0.00	0.00	0.	1.01	22.45	91	0.00	0.00	0.00	0.
1.01	10.30	42	0.00	0.00	0.00	0.	1.01	23.00	92	0.00	0.00	0.00	0.
1.01	10.45	43	0.00	0.00	0.00	0.	1.01	23.15	93	0.00	0.00	0.00	0.
1.01	11.00	44	0.00	0.00	0.00	0.	1.01	23.30	94	0.00	0.00	0.00	0.
1.01	11.15	45	0.00	0.00	0.00	0.	1.01	23.45	95	0.00	0.00	0.00	0.
1.01	11.30	46	0.00	0.00	0.00	0.	1.02	0.00	96	0.00	0.00	0.00	0.
1.01	11.45	47	0.00	0.00	0.00	0.	1.02	0.15	97	0.00	0.00	0.00	0.
1.01	12.00	48	0.00	0.00	0.00	0.	1.02	0.30	98	0.00	0.00	0.00	0.
1.01	12.15	49	0.00	0.00	0.00	0.	1.02	0.45	99	0.00	0.00	0.00	0.
1.01	12.30	50	0.00	0.00	0.00	0.	1.02	1.00	100	0.00	0.00	0.00	0.

					SUM	5.20 4.26 0.94 15516.
						(132.)(108)(24.)(439.36
CFS	1666.	642.	162.	155.	15516.	
CMS	47.	18.	5.	4.	439.	
INCHES		4.23	4.27	4.27	4.27	
MM		107.54	108.34	108.34	108.34	
AC-FT		318.	321.	321.	321.	
THOUS CU M		393.	395.	395	395.	

ROUTED FLOWS THROUGH RESERVOIR

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

GLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

STAGE	114.50	115.50	116.50	117.50	118.50	119.50	120.50	121.50	122.50
FLOW	0.00	75.00	212.00	765.00	1660.00	2788.00	4102.00	5581.00	7208.00
CAPACITY=	0.	21.	45.	74.	107.	144.	185.	231.	281.
ELEVATION=	115.	116.	117.	118.	119.	120.	121	122.	123.

CREL	SPWID	COGW	EXPW	ELEVL	COGL	CAREA	EXPL
114.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COGD	EXPD	DAMWID
116.5	0.0	0.0	0.

END-OF-PERIOD HYDROGRAPH ORDINATES

MO. DA	HR. MN	PERIOD	HOURS	INFLOW	OUTFLOW	STORAGE	STAGE
1.01	0.15	1	0.25	0.	0.	0.	114.5
1.01	0.30	2	0.50	0	0	0.	114.5
1.01	0.45	3	0.75	0	0.	0.	114.5
1.01	1.00	4	1.00	0.	0.	0.	114.5
1.01	1.15	5	1.25	0.	0.	0.	114.5
1.01	1.30	6	1.50	0.	0.	0.	114.5
1.01	1.45	7	1.75	2.	0.	0.	114.5
1.01	2.00	8	2.00	16.	1.	0.	114.5
1.01	2.15	9	2.25	44.	3	1.	114.5
1.01	2.30	10	2.50	91.	8.	2.	114.6
1.01	2.45	11	2.75	161.	16.	4	114.7
1.01	3.00	12	3.00	270	31.	8.	114.9
1.01	3.15	13	3.25	484.	56.	15	115.2
1.01	3.30	14	3.50	859.	113.	27.	115.8
1.01	3.45	15	3.75	1185.	212.	45.	116.5
1.01	4.00	16	4.00	1523	592.	65.	117.2
1.01	4.15	17	4.25	1666.	976.	82.	117.7
1.01	4.30	18	4.50	1613.	1266.	92.	118.1
1.01	4.45	19	4.75	1434.	1379	96.	118.2
1.01	5.00	20	5.00	1208.	1354.	96.	118.2
1.01	5.15	21	5.25	1006.	1246	92.	118.0
1.01	5.30	22	5.50	836.	1104	86.	117.9
1.01	5.45	23	5.75	694.	955.	81.	117.7
1.01	6.00	24	6.00	574.	815.	76.	117.6
1.01	6.15	25	6.25	474.	706.	71	117.4

BY JC DATE 6/3/21
CHKD. BY DATE
SUBJECT

LOUIS BERGER & ASSOCIATES INC.

SHEET NO 116 OF 114
PROJECT CC 2216

BY J.C. DATE 4/3/91

CHKD. BY ____ DATE ____

SUBJECT ____

LOUIS BERGER & ASSOCIATES INC.

SHEET NO 11 OF 11

PROJECT CS-276

1.01	6.30	26	6.50	387	614	66	117.2
1.01	6.45	27	6.75	311	526.	61	117.1
1.01	7.00	28	7.00	234	442.	57	116.9
1.01	7.15	29	7.25	140	357.	53	116.8
1.01	7.30	30	7.50	97.	277.	49	116.6
1.01	7.45	31	7.75	68.	213.	45.	116.5
1.01	8.00	32	8.00	48.	195.	42	116.4
1.01	8.15	33	8.25	33.	179.	39.	116.
1.01	8.30	34	8.50	23.	162.	36.	116.1
1.01	8.45	35	8.75	15.	147.	33.	116.0
1.01	9.00	36	9.00	10.	132.	31.	115.9
1.01	9.15	37	9.25	6.	119.	28.	115.8
1.01	9.30	38	9.50	3.	106.	26.	115.7
1.01	9.45	39	9.75	1.	95.	24.	115.6
1.01	10.00	40	10.00	0.	85.	22.	115.6
1.01	10.15	41	10.25	0.	76.	21.	115.5
1.01	10.30	42	10.50	0.	70.	19.	115.4
1.01	10.45	43	10.75	0.	65.	18.	115.4
1.01	11.00	44	11.00	0.	60.	16.	115.3
1.01	11.15	45	11.25	0.	56.	15.	115.2
1.01	11.30	46	11.50	0.	52.	14.	115.2
1.01	11.45	47	11.75	0.	48.	13.	115.1
1.01	12.00	48	12.00	0.	44.	12.	115.1
1.01	12.15	49	12.25	0.	41.	11.	115.0
1.01	12.30	50	12.50	0.	38.	10.	115.0
1.01	12.45	51	12.75	0.	35.	10.	115.0
1.01	13.00	52	13.00	0.	33.	9.	114.9
1.01	13.15	53	13.25	0.	31.	8.	114.9
1.01	13.30	54	13.50	0.	28.	8.	114.9
1.01	13.45	55	13.75	0.	26.	7.	114.9
1.01	14.00	56	14.00	0.	24.	7.	114.8
1.01	14.15	57	14.25	0.	23.	6.	114.8
1.01	14.30	58	14.50	0.	21.	6.	114.8
1.01	14.45	59	14.75	0.	19.	5.	114.8
1.01	15.00	60	15.00	0.	18.	5.	114.7
1.01	15.15	61	15.25	0.	17.	5.	114.7
1.01	15.30	62	15.50	0.	16.	4.	114.7
1.01	15.45	63	15.75	0.	14.	4.	114.7
1.01	16.00	64	16.00	0.	13.	4.	114.7
1.01	16.15	65	16.25	0.	12.	3.	114.7
1.01	16.30	66	16.50	0.	11.	3.	114.7
1.01	16.45	67	16.75	0.	11.	3.	114.6
1.01	17.00	68	17.00	0.	10.	3.	114.6
1.01	17.15	69	17.25	0.	9.	2.	114.6
1.01	17.30	70	17.50	0.	8.	2.	114.6
1.01	17.45	71	17.75	0.	8.	2.	114.6
1.01	18.00	72	18.00	0.	7.	2.	114.6
1.01	18.15	73	18.25	0.	7.	2.	114.6
1.01	18.30	74	18.50	0.	6.	2.	114.6
1.01	18.45	75	18.75	0.	6.	2.	114.6
1.01	19.00	76	19.00	0.	5.	1.	114.6
1.01	19.15	77	19.25	0.	5.	1.	114.6
1.01	19.30	78	19.50	0.	5.	1.	114.6
1.01	19.45	79	19.75	0.	4.	1.	114.6
1.01	20.00	80	20.00	0.	4.	1.	114.6
1.01	20.15	81	20.25	0.	4.	1.	114.5
1.01	20.30	82	20.50	0.	3.	1.	114.5
1.01	20.45	83	20.75	0.	3.	1.	114.5
1.01	21.00	84	21.00	0.	3.	1.	114.5
1.01	21.15	85	21.25	0.	3.	1.	114.5
1.01	21.30	86	21.50	0.	3.	1.	114.5
1.01	21.45	87	21.75	0.	2.	1.	114.5
1.01	22.00	88	22.00	0.	2.	1.	114.5
1.01	22.15	89	22.25	0.	2.	1.	114.5
1.01	22.30	90	22.50	0.	2.	1.	114.5
1.01	22.45	91	22.75	0.	2.	0.	114.5
1.01	23.00	92	23.00	0.	2.	0.	114.5
1.01	23.15	93	23.25	0.	1.	0.	114.5
1.01	23.30	94	23.50	0.	1.	0.	114.5
1.01	23.45	95	23.75	0.	1.	0.	114.5
1.02	0.00	96	24.00	0.	1.	0.	114.5
1.02	0.15	97	24.25	0.	1.	0.	114.5
1.02	0.30	98	24.50	0.	1.	0.	114.5
1.02	0.45	99	24.75	0.	1.	0.	114.5
1.02	1.00	100	25.00	0.	1.	0.	114.5

PEAK OUTFLOW IS 1379. AT TIME 4.75 HOURS

CFS	1379	587.	162.	155.	15508.
CMS	39.	17.	5.	4.	439.
INCHES		3.87	4.26	4.26	4.26
MM		98.29	108.28	108.28	108.28
AC-FT		291	320.	320.	320
THOUS CU M		359.	395.	395.	395

RUNOFF SUMMARY, AVERAGE FLOW IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES(SQUARE KILOMETERS)

HYDROGRAPH AT	1	1666	642.	162.	155.	1.41
		(47.17)(	18.17)(	4.58)(	4.39)(	3.65)
ROUTED TO	2	1379	587.	162	155.	1.41
		(39.04)(	16.61)(	4.57)(	4.39)(	3.65)

SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	114.50	114.50	116.50
STORAGE	0.	0.	45.
OUTFLOW	0.	0.	212.

RATIO OF PMF	MAXIMUM RESERVOIR W.S. ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.00	118.19	1.69	96.	1379.	4.00	4.75	0.00

END

DATE
FILMED

9 - 81

DTIC